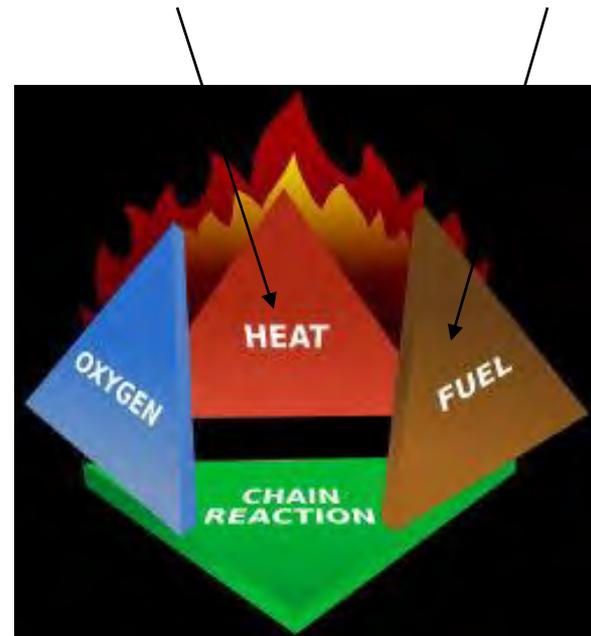


# Bilancia Ignition Matrix™

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**May 2015**

# Bilancia Ignition Matrix™ Approach

- **Developed by Lou Bilancia, P.E., Oregon**
- **This approach exhaustively compares all potential ignition sources and all first fuels in the room of origin.**



# The Matrix

- Exhaustive pair-wise comparison designed to systematically evaluate numerous ignition sources and document how each was or was not competent to ignite a particular first fuel
- All potential ignition sources listed across the top and all possible first fuels down the side.
- Each square then represents a pair-wise assessment of the interaction between each fuel and each source

Source ----- Fuel	clock radio	cell phone charger	cigarette	candle	compact fluorescent lamp	plug-in room refresher
Lace night table cover	1. yes (a) 2. yes, close 3. no (d) 4. yes path	1. yes (a, c) 2. not close 3. 4. yes	1. 2. yes close 3. no evid. 4.	1. yes comp 2. yes 3. maybe 4. yes	1. yes (a, c) 2. yes 3. no (d) 4. yes gravity	1. yes (a) 2. not close 3. no (d) 4.
Sheets or covers	1. no (c) 2. not close 3. no (d) 4. yes gravity	1. yes (a, c) 2. yes close 3. no (d) 4. yes	1. 2. not close 3. no evid. 4.	1. yes comp 2. not close 3. 4.	1. yes (a, c) 2. no 3. no (d) 4. no	1. yes (a) 2. yes close 3. 4.
Curtains	1. no (c) 2. not close 3. no (d) 4. yes path	1. yes (a, c) 2. yes close 3. no (d) 4. yes	1. 2. not close 3. no evid. 4.	1. yes comp 2. not close 3. 4.	1. yes (a, c) 2. no 3. no (d) 4. yes shade	1. yes (a) 2. yes close 3. no (d) 4.
Plastic decorative flowers	1. no (c) 2. not close 3. no (d) 4.	1. yes (a, c) 2. not close 3. no (d) 4. no	1. not comp. 2. 3. no evid 4.	1. yes comp 2. yes close 3. maybe 4. yes	1. no (a, c) 2. no 3. no (d) 4. yes shade	1. no (a, c) 2. not close 3. no (d) 4. no
Lamp shade	1. yes comp 2. not close 3. no (d) 4. yes path	1. yes (a, c) 2. not close 3. no (d) 4. no	1. 2. not close 3. no evid 4.	1. yes comp 2. not close 3. indirect 4. yes path	1. no (a, c) 2. yes close 3. no (d) 4. yes	1. no (c) 2. yes close 3. no (d) 4. no

# Evaluation

- **Each combination is then evaluated on four primary values:**
  1. Is this ignition source competent to ignite this fuel – yes or no?
  2. Is this ignition source close enough to this fuel to be capable of igniting it – yes or no?
  3. Is there evidence of ignition – yes or no?
  4. Is there a pathway for a fire ignited in this fuel to ignite the main fuel – yes or no?

# Assessment

- **Comments or notes on each evaluation**
  - **This source was not energized (appliance or power cord) or not in use (candle)**
  - **“Too far away” or “Depends on duration being adequate” or “Unknown – must test exemplar”**
  - **Physical or visual evidence of burning, ignition was witnessed or recorded on video**
  - **Plume developed from first fuel sufficient or ignited by flashover**

# Competent Ignition Source?

- 1. Is this ignition source competent to ignite this fuel – yes or no?**
  - 1. How much energy does this source have?**
  - 2. What percentage is in radiant/convected/conducted?**
  - 3. How will this energy be transferred?**
  - 4. How will my target fuel react?**
  - 5. What kind of fuel is it?**
  - 6. What is its ignition temperature?**

# Physical Distance?

2. Is this ignition source close enough to this fuel to be capable of igniting it – yes or no?
  1. How will the energy be transferred?
  2. How will the fuel react?
  3. Where is the source compared to the fuel?

# Was this fuel actually burned?

3. Is there evidence of ignition – yes or no?

1. Charring

2. Consumption

3. Where is the fire damage?

4. Was it energized?

Plugged in, turned on, lighted?

# Pathway or Ladder Fuel?

4. Is there a pathway for a fire ignited in this fuel to ignite the main fuel – yes or no?
  1. If it's not the main fuel driving the fire, how did it contribute?
  2. Where is it?
  3. How big a fire will it produce?

# Bilancia Ignition Matrix™

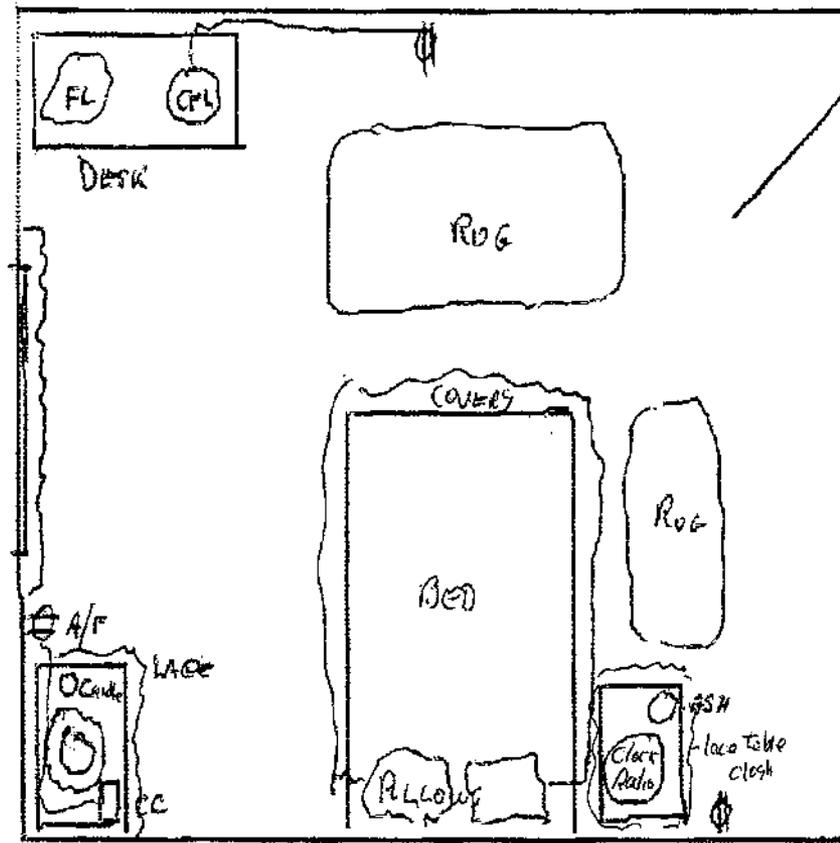
- Finally the matrix can be color-coded to indicate which combinations are capable, which are excluded, and which need further data
- For example:
  - Red: Competent and close
  - Blue: Not competent
  - Yellow: Competent but ruled out

Source ----- Fuel	clock radio	cell phone charger	cigarette	candle	compact fluorescent lamp	plug-in room refresher
Lace night table cover	1. yes (a) 2. yes, close 3. no (d) 4. yes path	1. yes (a, c) 2. not close 3. 4. yes	1. 2. yes close 3. no evid. 4.	1. yes comp 2. yes 3. maybe 4. yes	1. yes (a, c) 2. yes 3. no (d) 4. yes gravity	1. yes (a) 2. not close 3. no (d) 4.
Sheets or covers	1. no (c) 2. not close 3. no (d) 4. yes gravity	1. yes (a, c) 2. yes close 3. no (d) 4. yes	1. 2. not close 3. no evid. 4.	1. yes comp 2. not close 3. 4.	1. yes (a, c) 2. no 3. no (d) 4. no	1. yes (a) 2. yes close 3. 4.
Curtains	1. no (c) 2. not close 3. no (d) 4. yes path	1. yes (a, c) 2. yes close 3. no (d) 4. yes	1. 2. not close 3. no evid. 4.	1. yes comp 2. not close 3. 4.	1. yes (a, c) 2. no 3. no (d) 4. yes shade	1. yes (a) 2. yes close 3. no (d) 4.
Plastic decorative flowers	1. no (c) 2. not close 3. no (d) 4.	1. yes (a, c) 2. not close 3. no (d) 4. no	1. not comp. 2. 3. no evid 4.	1. yes comp 2. yes close 3. maybe 4. yes	1. no (a, c) 2. no 3. no (d) 4. yes shade	1. no (a, c) 2. not close 3. no (d) 4. no
Lamp shade	1. yes comp 2. not close 3. no (d) 4. yes path	1. yes (a, c) 2. not close 3. no (d) 4. no	1. 2. not close 3. no evid 4.	1. yes comp 2. not close 3. indirect 4. yes path	1. no (a, c) 2. yes close 3. no (d) 4. yes	1. no (c) 2. not close 3. no (d) 4. no

# Bilancia Ignition Matrix™

- **Applicable to any fire scene, once the room or area of origin has been determined**

# The Key Element: The Treasure Map



Fuels  
Ignition sources

# Evaluation of a bedroom fire

Source Fuel	Clock Radio	Cell Phone Charger	Cigarettes	Candle	Compact Fluorescent Lamp	Plug-In Room Freshener	Receptacles Fixed Wiring	Open Flame
Lace Night Table Cover	1. no 2. yes 3. no (b) 4. yes	1. yes (a,c) 2. yes 3. no? 4. yes	1. yes 2. yes? 3. yes 4. yes	1. yes 2. yes 3. no (d) 4. yes	1. no? N 2. no 3. no 4. no	1. no 2. yes (e) 3. no 4. yes	1. yes (a) 2. yes 3. no 4. yes?	1. yes 2. ? 3. no 4. yes? cases
Sheets/ Bedcovers	1. yes (a) 2. yes 3. no (d) 4. yes	1. no 2. no? 3. yes 4. yes	1. yes 2. yes? 3. no 4. yes?	1. yes 2. no 3. no (d) 4. no	1. yes (a) 2. no N 3. no 4. no	1. no 2. no 3. no 4. no	1. yes (a) 2. no 3. no 4. no	1. yes 2. ? 3. no? 4. yes
Curtains	1. no 2. no 3. no (b) 4. no	1. no 2. no 3. no? 4. no	1. no 2. no 3. no 4. no	1. yes 2. yes 3. no (d) 4. no?	1. yes (a) 2. no N 3. no 4. no	1. yes? (a) 2. yes 3. no 4. yes	1. yes (a) 2. yes 3. no 4. yes	1. yes 2. ? 3. no? 4. yes
'Plastic' Flowers	1. no 2. no 3. no (b) 4. no	1. no 2. no 3. no? 4. no	1. no 2. no 3. no 4. no	1. yes 2. no 3. no (d) 4. no	1. yes (a) 2. yes 3. no N 4. no	1. no 2. no 3. no 4. no	1. no 2. no 3. no 4. no	1. yes 2. ? 3. no 4. yes
Lamp shade	1. yes (a) 2. no 3. no (d) 4. no	1. no 2. yes 3. no? 4. no	1. no 2. no? 3. no? 4. no	1. yes 2. yes 3. no (d) 4. no	1. yes (a) 2. no? 3. no N 4. no	1. no 2. no 3. no 4. no	1. no 2. no 3. no 4. no	1. yes 2. no? 3. no 4. yes
Rugs	1. no 2. no 3. no (b) 4. no	1. no 2. no 3. no? 4. no	1. no? 2. no 3. yes 4. yes?	1. no? 2. no 3. no (b) 4. no	1. no 2. no 3. no N 4. no	1. no 2. no 3. no 4. no?	1. yes? 2. no 3. no 4. no	1. no? 2. no? 3. no 4. yes

# Color Aids Interpretation

Source ----- Fuel	clock radio	cell phone charger	cigarette	candle	compact fluorescent lamp	plug-in room refresher
<b>Lace night table cover</b>	1. yes (a) 2. yes, close 3. no (d) 4. yes path	1. yes (a, c) 2. not close 3. 4. yes	1. 2. yes close 3. no evid. 4.	1. yes comp 2. yes 3. maybe 4. yes	1. yes (a, c) 2. yes 3. no (d) 4. yes gravity	1. yes (a) 2. not close 3. no (d) 4.
<b>Sheets or covers</b>	1. no (c) 2. not close 3. no (d) 4. yes gravity	1. yes (a, c) 2. yes close 3. no (d) 4. yes	1. 2. not close 3. no evid. 4.	1. yes comp 2. not close 3. 4.	1. yes (a, c) 2. no 3. no (d) 4. no	1. yes (a) 2. yes close 3. 4.
<b>Curtains</b>	1. no (c) 2. not close 3. no (d) 4. yes path	1. yes (a, c) 2. yes close 3. no (d) 4. yes	1. 2. not close 3. no evid. 4.	1. yes comp 2. not close 3. 4.	1. yes (a, c) 2. no 3. no (d) 4. yes shade	1. yes (a) 2. yes close 3. no (d) 4.
<b>Plastic decorative flowers</b>	1. no (c) 2. not close 3. no (d) 4.	1. yes (a, c) 2. not close 3. no (d) 4. no	1. not comp. 2. 3. no evid 4.	1. yes comp 2. yes close 3. maybe 4. yes	1. no (a, c) 2. no 3. no (d) 4. yes shade	1. no (a, c) 2. not close 3. no (d) 4. no
<b>Lamp shade</b>	1. yes comp 2. not close 3. no (d) 4. yes path	1. yes (a, c) 2. not close 3. no (d) 4. no	1. 2. not close 3. no evid 4.	1. yes comp 2. not close 3. indirect 4. yes path	1. no (a, c) 2. yes close 3. no (d) 4. yes	1. no (c) 2. not close 3. no (d) 4. no

# Bilancia Ignition Matrix™ **Example**

- **Kitchen Fires:**
  - Numerous first fuels
    - Fixed and occasional
  - Numerous heat sources
    - “Intentional” and accidental



# Living Rooms – Fuels and Sources



# Color Aids Interpretation

Source ----- Fuel	clock radio	cell phone charger	cigarette	candle	compact fluorescent lamp	plug-in room refresher
<b>Lace night table cover</b>	1. yes (a) 2. yes, close 3. no (d) 4. yes path	1. yes (a, c) 2. not close 3. 4. yes	1. 2. yes close 3. no evid. 4.	1. yes comp 2. yes 3. maybe 4. yes	1. yes (a, c) 2. yes 3. no (d) 4. yes gravity	1. yes (a) 2. not close 3. no (d) 4.
<b>Sheets or covers</b>	1. no (c) 2. not close 3. no (d) 4. yes gravity	1. yes (a, c) 2. yes close 3. no (d) 4. yes	1. 2. not close 3. no evid. 4.	1. yes comp 2. not close 3. 4.	1. yes (a, c) 2. no 3. no (d) 4. no	1. yes (a) 2. yes close 3. 4.
<b>Curtains</b>	1. no (c) 2. not close 3. no (d) 4. yes path	1. yes (a, c) 2. yes close 3. no (d) 4. yes	1. 2. not close 3. no evid. 4.	1. yes comp 2. not close 3. 4.	1. yes (a, c) 2. no 3. no (d) 4. yes shade	1. yes (a) 2. yes close 3. no (d) 4.
<b>Plastic decorative flowers</b>	1. no (c) 2. not close 3. no (d) 4.	1. yes (a, c) 2. not close 3. no (d) 4. no	1. not comp. 2. 3. no evid 4.	1. yes comp 2. yes close 3. maybe 4. yes	1. no (a, c) 2. no 3. no (d) 4. yes shade	1. no (a, c) 2. not close 3. no (d) 4. no
<b>Lamp shade</b>	1. yes comp 2. not close 3. no (d) 4. yes path	1. yes (a, c) 2. not close 3. no (d) 4. no	1. 2. not close 3. no evid 4.	1. yes comp 2. not close 3. indirect 4. yes path	1. no (a, c) 2. yes close 3. no (d) 4. yes	1. no (c) 2. not close 3. no (d) 4. no

# Vehicle Fires: Fuels and Sources?



# Newer Vehicles – More Sources?



# Vehicles - Lots of Both!





# Bilancia Ignition Matrix™ Approach

- **Encourages the investigator to consider a comprehensive range of alternative hypotheses and consider each one on the basis of factors such as: heat release rate, heat flux, separation distances, thermal inertia, and routes of fire spread.**
- **It is an exhaustive approach using the true intent of the scientific method**
- **A completed matrix offers a concise demonstration that all potential ignition sources have been considered and all (but one, presumably) has been eliminated**

# Bilancia Ignition Matrix™

- **It is a critical part of your documentation of the investigation.**
- **Deliberate ignition with open flame can be included.**
- **Note that this comprehensive approach is NOT the casual “process of elimination” that NFPA 921 strongly cautions against using (NFPA 921, 2011 ed., pt.18.6.5 and 2014 ed., pt.19.6.5)**
- **It is cited as a suitable protocol in Kirk’s 7<sup>th</sup> ed. and Forensic Fire Scene Reconstruction.**